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RHYTHM PUZZLE - ANSWER

A supraventricular tachycardia showing alternation of the QRS interval

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Answer to the rhythm puzzle

Careful examination of the ECG in Fig. 1a of the question shows a narrow QRS complex tachycardia of 170 bpm with alternating RR intervals (short-long-short etc.). In addition, the QRS complexes alternate in R amplitude. There are no clear P waves present. The differential diagnosis of this tachycardia is:

1) Orthodromic atrioventricular reentry tachycardia (AVRT) with alternating AV conduction over a slow and a fast AV nodal pathway and constant VA conduction over an accessory pathway.
2) Sinus rhythm with 1:2 AV conduction over dual AV nodal pathways.

In case of the first possibility (AVRT), an accessory pathway is responsible for the retrograde limb of the tachycardia circuit (there is no evidence for anterograde conduction over the accessory pathway on the ECG in sinus rhythm, as show in Fig. 1b of the question). Therefore a 'concealed' accessory pathway must be present. Anterograde conduction occurs over a dual AV nodal pathway (Fig. 2, upper panel). This alternating conduction over the slow and the fast pathway creates a 'regular irregularity' as evidenced by the short-long-short RR intervals. This alternating RR interval is also responsible for the alternation in R amplitudes.

The second possibility is sinus rhythm with 1:2 AV conduction over dual AV nodal pathways, each atrial activation is followed by two QRS complexes (the first through the fast pathway and the second through the slow pathway (Fig. 2, lower panel). This will also result in a 'regular irregularity' and alternating R amplitudes as seen in Fig. 1a.

Although adenosine could stop both the mechanisms, the combination of the sudden stop and the age of the patient make the first option more likely than the second option. Ideally, an electrophysiological study should be performed to identify the exact mechanism of the tachycardia. In the second situation, catheter ablation of the slow AV nodal pathway is required to obtain a definite cure. In the first situation, following ablation of the accessory pathway, additional slow AV nodal pathway ablation is indicated if AV nodal reentrant tachycardia can be initiated during programmed stimulation. However, the patient is currently free of symptoms after initiation of oral verapamil and does not wish to undergo an electrophysiological study at this moment. Therefore, the precise mechanism remains uncertain.

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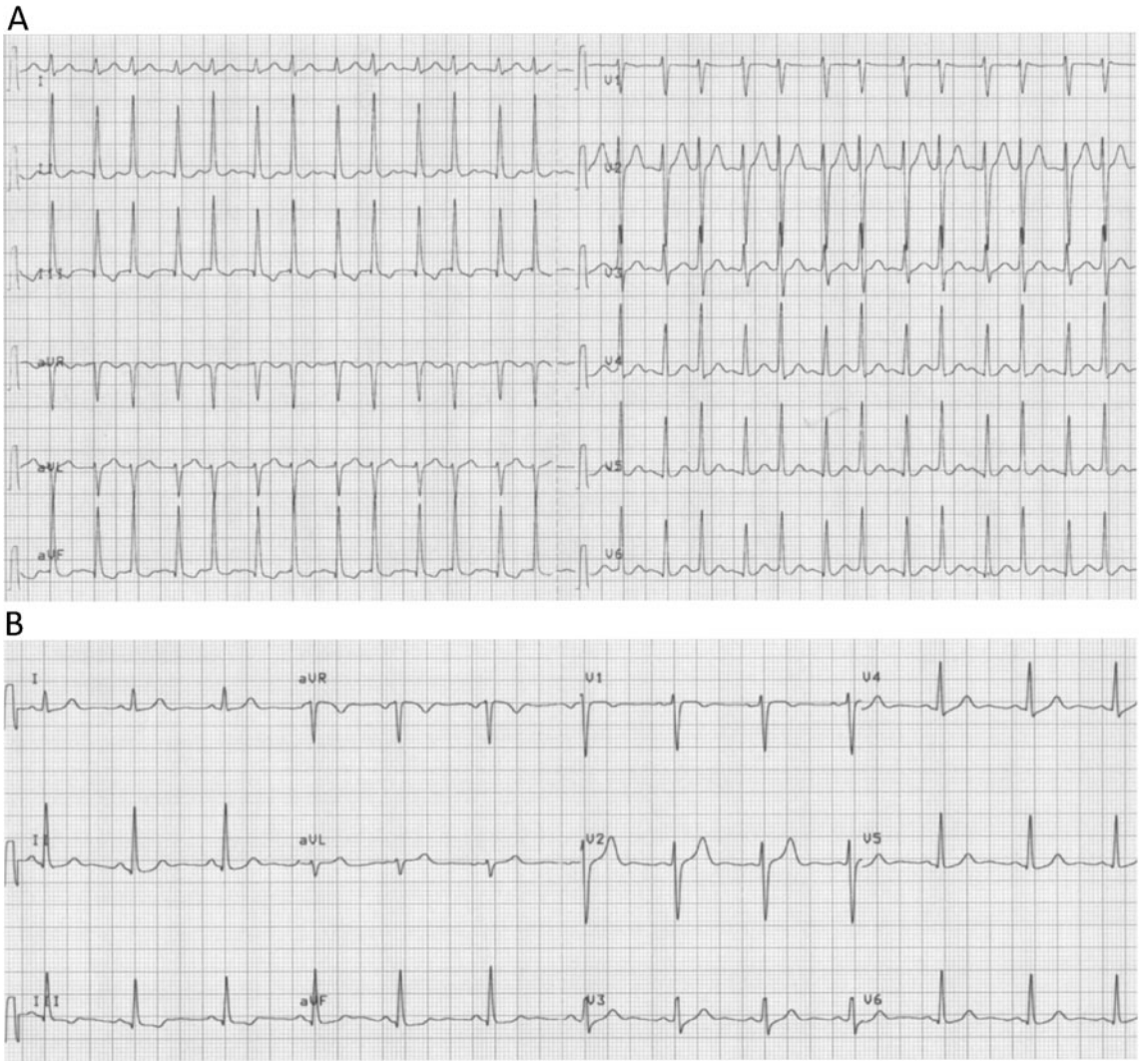

Fig. 1 **a** Narrow complex tachycardia of approximately 170 bpm upon presentation; **b** ECG after administration of adenosine showing sinus rhythm of 70 bpm

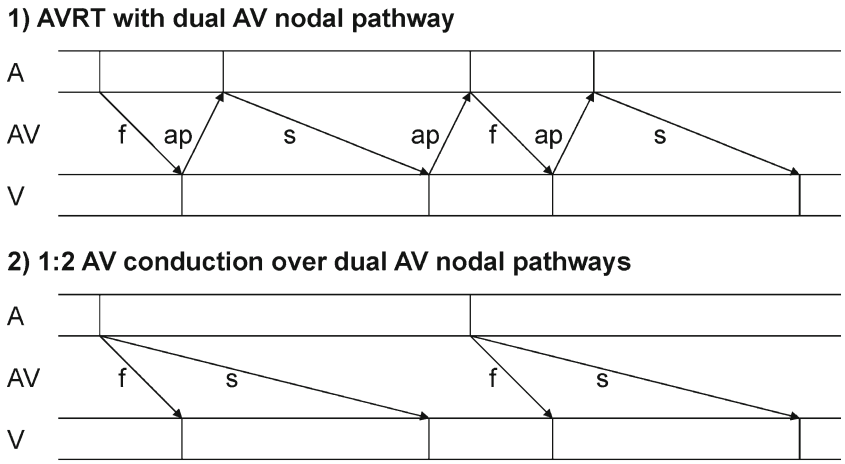

Fig. 2 Ladder diagrams explaining the two possible mechanisms of the tachycardia. *Upper panel*: The impulse is travelling in a retrograde fashion to the atrium via the accessory pathway (ap) and then anterogradely to the ventricle, alternating over the slow (s) and fast AV nodal pathway (f). *Lower panel*: The impulse during sinus rhythm is travelling anterogradely from the atrium to the ventricle, alternating over the fast (f) and then the slow AV nodal pathway (s) resulting in two QRS complexes after each sinus P wave